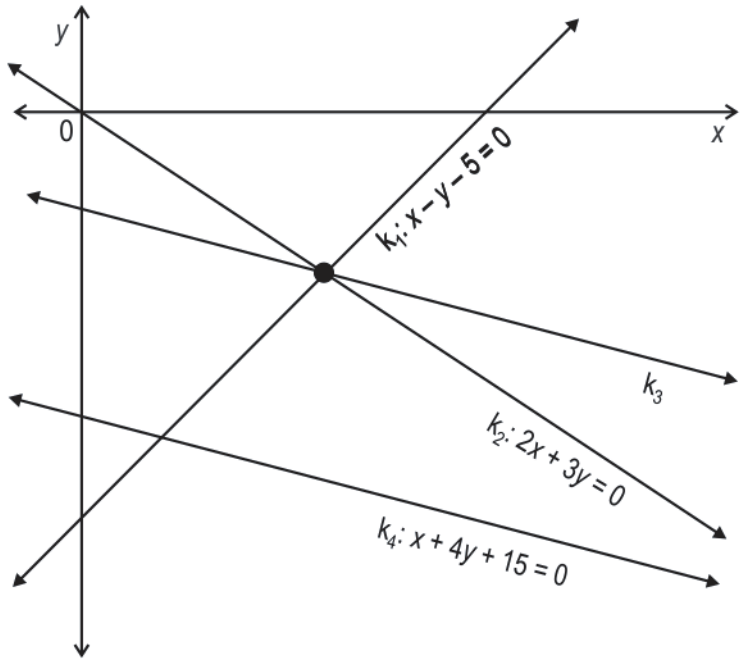
Chapter - 3
Pair of Linear Equations in Two Variables

Q: 1 **Shown below is a graph with four straight lines. It is given that lines k_1, k_2 and k_3 intersect at exactly one point and line $k_3 \parallel k_4$.**



Which of the following is the equation of line k_3?

1 $x + y - 1 = 0$
2 $x + 4y + 5 = 0$
3 $x - 4y - 11 = 0$
4 $2x + 8y + 35 = 0$

Q: 2 **Harsh correctly solved a pair of linear equations in two variables and found their only point of intersection as (3, -2). One of the lines was $x - y = 5$.**

Which of the following could have been the other line?

I: $3x - 3y = 15$
II: $2x - 3y = 12$
III: $2x - 3y = 14$

1 only I
2 only II
3 only I and II
4 only II and III

Q: 3 **Two linear equations in variables *x* and *y* are given below.**

$a_1 x + b_1 y + c = 0$
$a_2 x + b_2 y + c = 0$

Which of the following pieces of information is independently sufficient to determine if a solution exists or not for this pair of linear equations?

I: $\frac{a_1}{b_1} = \frac{a_2}{b_2} = 1$

II: $\frac{a_1}{a_2} = \frac{b_1}{b_2}$

III: $\frac{a_1}{a_2} = \frac{a_1}{b_1} \neq 1$

IV: $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$

1 IV **2** I and IV **3** II and IV **4** I and III

Q: 4 **The ratio of a two-digit number and the sum of its digits is 7:1. How many such two-digit numbers are possible?**

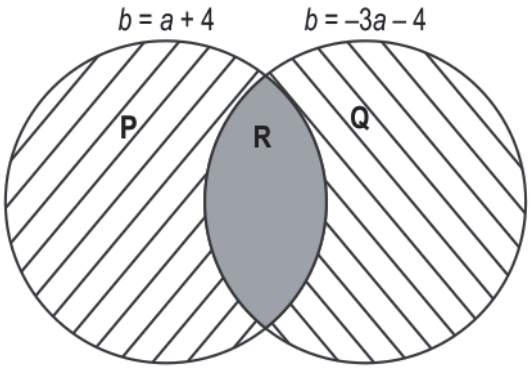
1 1 **2** 4 **3** 9 **4** (infinitely many)

Q: 5 **If a pair of linear equations given by $a_1 x + b_1 y + c_1 = 0$ and $a_2 x + b_2 y + c_2 = 0$ has a unique solution, then which of the following is true?**

1 $a_1 a_2 = b_1 b_2$ **2** $a_1 b_2 \neq a_2 b_1$ **3** $\frac{a_1}{a_2} = \frac{b_1}{b_2}$ **4** $\frac{a_1}{b_2} \neq \frac{b_1}{a_2}$

Q: 6 **Write a pair of linear equations in 2 variables which have infinite solutions.** **[1]**

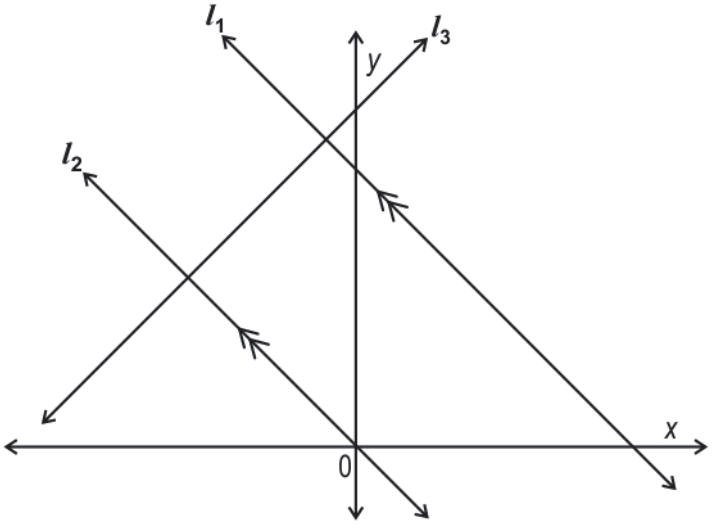
Q: 7 **The two circles represent the ordered pairs, (a, b), which are solutions of the respective equations. The circles are divided into 3 regions P, Q and R as shown.** **[3]**



Write one ordered pair each belonging to P, Q and R. Show your work.

Q: 8 **Shown below is a graph representing straight lines l_1, l_2 and l_3 such that:** **[3]**

- **l_2 is parallel to l_1 and l_3 intersects l_1 at exactly one point.**
- **The equation of l_1 is $x + y = k$, where k is a real number.**



Based on the above information, identify if the statements below are true or false. Justify your answer.

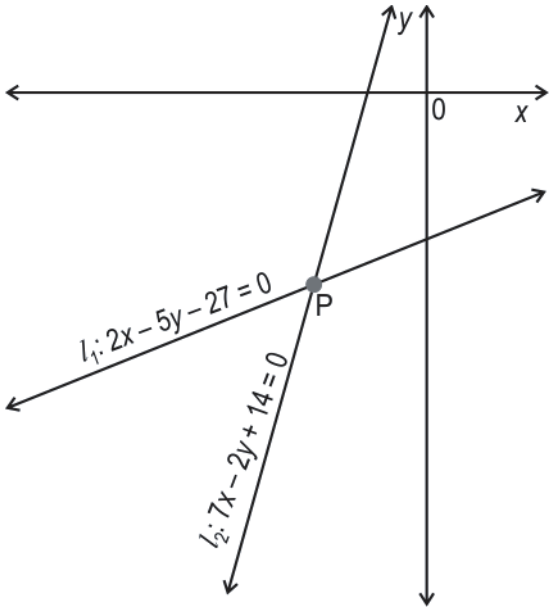
i) $2x + 2y = 2k$ can be the equation of l_2.
ii) $(-x) + y = k$ can be the equation of l_3.

Q: 9 **Shown below is a pair of linear equations.** **[3]**

$x + 0.999\,y = 2.999$
$0.999\,x + y = 2.998$

i) Without finding the values of x and y, prove that $x - y = 1$.
ii) Find the values of x and y. Show your work.

Q: 10 **Shown below are lines $l_1 : 2x - 5y - 27 = 0$ and $l_2 : 7x - 2y + 14 = 0$.** **[2]**



Write the equation of a line l_3, in two variables, such that it intersects l_1 and l_2 exactly at one point, P. Show your work.

Q: 11 **Given below are two lines such that $l_1 \parallel l_2$.** **[3]**

$l_1 : 2x + 2y + 2 = 0$
$l_2 : 3x - 3y + 3 = 0$

i) Using comparison of ratios of coefficients, write the equation of a line l_3, in two variables, such that it intersects l_1 at exactly one point.
ii) Find the point of intersection of l_2 and l_3.

Show your steps.

Q: 12 **A company has a locker in which valuable documents are kept. The passcode is a four digit number of the form *xyyx*. The Chief Executive Officer (CEO) and the Vice President (VP) of the company have each been given one clue. On solving BOTH clues, the passcode that opens the locker can be found.** **[3]**

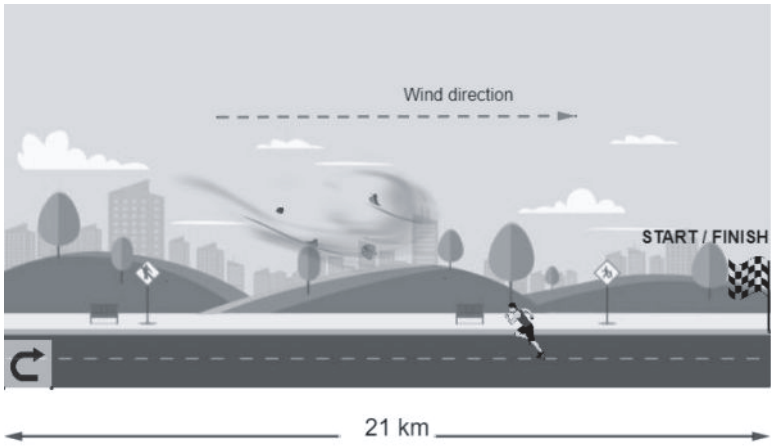
CEO's clue: When twice the ones digit is subtracted from the tens digit, the result is 1.

VP's clue: Three more than the tens digit is thrice the ones digit.

Find the passcode that opens the locker. Show your work.

Q: 13 **At the Bengaluru marathon, the 42 km route is designed such that marathoners run in a straight line for 21 km, and return back along the same path in the opposite direction.** **[3]**

A marathoner, running against the wind, covered the first half of the marathon in 2 hours. Then, he covered the second half, running with the wind, in 1.5 hours. Assume that the marathoner ran at a constant speed and that the wind speed and direction did not change throughout the marathon.



(Note: The figure is not to scale.)

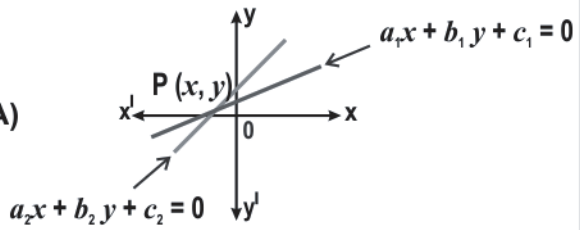
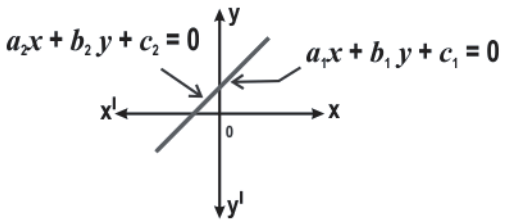
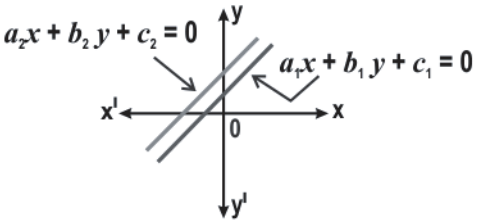
Calculate the speed (in km/h) of the marathoner and the wind. Show your steps.

Q: 14 **A new intra-city transportation startup has employed both taxis and auto rickshaws. The night fare for a taxi is Rs 9 for the first half kilometre and Rs 15 per kilometre thereafter, while the night fare for an auto rickshaw is Rs 20 for the first one kilometre and Rs 13 per kilometre thereafter.** **[3]**

i) Express the night fare structure for taxis and auto rickshaws in the form of linear equations. Use *f* as the fare (in Rs) and *d* as the distance travelled (in km).

ii) At what distance is the night fare for a taxi and an auto rickshaw equal? Show your steps.

Q: 15 **Match the graphical representation in column I with their corresponding criteria in column II and consequences in column III.** **[3]**

COLUMN I	COLUMN II	COLUMN III
A) 	1) $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$	i) Infinitely many solutions
B) 	2) $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$	ii) No solution
C) 	3) $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$	iii) Exactly one solution

(Note: Match the alphabets A), B), C) in column I with the corresponding numbers 1), 2), 3) in column II and i), ii), iii) in column III respectively.)

Q: 16 **Arvind owns a dry-fruits store. He sells cashew nuts at Rs 600/kg and pistachio nuts at Rs 750/kg.** **[3]**

A customer asks for a mixture of cashew nuts and pistachio nuts with the following conditions:

- **both the items should together weigh 500 g.**
- **both the items should together cost Rs 360.**

i) If Arvind packs *x* kg of cashew nuts and *y* kg of pistachio nuts for the customer, frame the equations that represent the given context.

ii) Find the weights of cashew nuts and pistachio nuts that Arvind packed for the customer.

Show your work.

Q: 17 **Is the pair of linear equations x = p and y = q consistent? Justify your answer.** **[1]**

(Note: p and q are constants)

Q: 18 **The four-wheeler parking fees at a metro station is charged in two parts - a fixed charge of Rs x up to 2 hours and Rs y for every subsequent hour.** **[5]**

i) Murli parked his car for 6 hours and paid Rs 110. Aparna parked her car for 13 hours and paid Rs 250. Frame a pair of linear equations representing the context and find the fixed charge and the subsequent charge per hour.

ii) Amish parked his car at the station from 8 AM to 3 PM. Find the amount Amish must pay as the parking charges.

Show your work.

Q: 19 **Ananya had red, blue and yellow marbles in the ratio 4:5:3. She gave all her red marbles and some blue marbles to Neha. The ratio of the number of blue marbles and yellow marbles left with Ananya was 7:9.** **[5]**
If Ananya gave 20 marbles to Neha, how many of them are red marbles? Show your work.

Q: 20 **Given below is a non-linear equation.** **[1]**

$$\frac{3(x+y)+7(x-y)}{x^2-y^2}=12$$

Garima has reduced it to a linear equation in two variables. Shown below are her steps.

Step 1: $\frac{3(x+y)+7(x-y)}{(x+y)(x-y)}=12$

Step 2: $\frac{3}{(x+y)}+\frac{7}{(x-y)}=12$

Step 3: Takes $\frac{1}{(x+y)}=a$ **and** $\frac{1}{(x-y)}=b$

Step 4: $3a+7b=12$

However, she has made a mistake in one step. Identify the erroneous step and complete the solution.

Answer the questions based on the given information.

The total cost of snowden ice cream parlour is divided into fixed cost (x) and variable cost (y). Fixed cost is the cost that the ice cream parlour has to incur even at zero level of production and variable cost is the cost that will be directly proportional to each unit of ice cream sold.

The parlour launched a new flavour of ice cream and wanted to find the fixed and variable cost associated with it. They found that their total cost for that flavour was Rs 27500 after selling 150 units and Rs 32500 after selling 250 units.

Q: 21 **Frame the equations that represent the total cost incurred by snowden ice cream parlour for the new flavour in terms of fixed and variable costs.** **[1]**

Q: 22 **Find the fixed cost incurred by the ice cream parlour for the new flavour. Show your work.** **[1]**

Q: 23 **Find the variable cost per unit incurred by the ice cream parlour for the new flavour. Show your work.** **[1]**

Q: 24 **The break-even point of a new flavour ice cream is the number of units sold at which the total cost price of the ice cream is the same as the total selling price. The parlour launches another new flavour whose fixed cost is Rs 10000, variable cost is Rs 40 and the selling price of each unit Rs 60.** **[2]**

Find the number of units at the break-even point of the other new flavour. Show your work.

The table below gives the correct answer for each multiple-choice question in this test.

Q.No	Correct Answers
1	2
2	2
3	2
4	2
5	2

Q.No	Teacher should award marks if students have done the following:	Marks
6	**Writes 2 equations in the form, a *x* +b *y* = c and ka *x* + kb *y* = kc. For example, 2 *x* + 3 *y* = 1, 6 *x* + 9 *y* = 3.**	**1**
7	**Writes a coordinate for the region P and Q as (0, 4) and (0, -4) respectively.**	**1**
	Solves the pair of equations as *a* + 4 = -3 *a* - 4 to get the value of *a* as $\frac{-8}{4}$ = -2.	**1**
	Uses the above step to find the value of *b* as -2 + 4 = 2.	**0.5**
	Writes the coordinate for region R as (-2, 2).	**0.5**
8	i) For two lines to be parallel, $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$ and compares l_1 and l_2 as $\frac{1}{2} = \frac{1}{2} = \frac{1}{2}$.	**1**
	Uses the above step to write that as 2 *x* + 2 *y* = 2 *k* is not parallel to l_1, it cannot be the equation of l_2.	**0.5**
	ii) For two lines to intersect at exactly one point, $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$ and compares l_1 and l_3 as $\frac{1}{-1} \neq \frac{1}{1}$.	**1**
	Uses the above step to write that as (- *x*) + *y* = *k* intersects l_1 at exactly one point, it can be the equation of l_3.	**0.5**
9	**i) Subtracts the given equations and finds that *x* - *y* = 1.**	**1.5**
	ii) Solves any two equations and finds the values of *x* and *y* as 2 and 1 respectively.	**1.5**
10	**Solves the equations of l_1 and l_2 to get the point of intersection as (-4, -7).**	**1**
	Writes an equation for l_3 such that it passes through (-4, -7). For example, *x* + *y* + 11 = 0.	**1**

Q.No	Teacher should award marks if students have done the following:	Marks
11	i) Assumes the equation of line l_3 as $ax + by = c$ where a, b and c are non-zero real numbers and writes the condition for l_1 and l_3 to have a unique solution as $\frac{2}{a} \neq \frac{2}{b}$.	1
	Writes an equation of l_3 that satisfies the above condition. For example, $2x + y - 1 = 0$ since $\frac{2}{2} \neq \frac{2}{1}$.	0.5
	ii) Solves the equations of lines l_2 and l_3 correctly to find the point of intersection. For example, if l_3 is $2x + y - 1 = 0$, then the point of intersection of l_2 and l_3 is (0, 1).	1.5
12	Translates the given clues to frame a pair of linear equations in two variables as: $y - 2x = 1$ $y + 3 = 3x$	1
	Solves the pair of equations obtained in the above step to find the values of x and y as 4 and 9 respectively.	1.5
	Concludes that the passcode of the locker is 4994.	0.5
13	Assumes the marathoner's speed as m km/h and the wind's speed as w km/h. Takes the marathoner's effective speeds as ($m - w$) km/h for the first half and ($m + w$) km/h for the second half.	0.5
	Formulates the pair of linear equations as: $m - w = \frac{21}{2}$ $m + w = \frac{21}{1.5}$	0.5
	Solves the pair of linear equations to find the value of m as $\frac{49}{4}$ km/hr or 12.25 km/hr. (Award full marks if the answer is provided in the form of an equivalent fraction.)	1
	Finds the value of w by substituting the value of m in either of the two equations from step (2) as $\frac{7}{4}$ km/hr or 1.75 km/hr. (Award full marks if the answer is provided in the form of an equivalent fraction.)	1

Q.No	Teacher should award marks if students have done the following:	Marks
14	i) Expresses the taxi's night fare structure in the form of an equation as $f = 9 + 15(d - 0.5)$ $\Rightarrow f = 15d + 1.5$ (Award full marks if any other correct variation of the equation is written.)	1
	Expresses the auto rickshaw's night fare structure in the form of an equation as $f = 20 + 13(d - 1)$ $\Rightarrow f = 13d + 7$ (Award full marks if any other correct variation of the equation is written.)	1
	ii) Solves the pair of linear equations obtained in steps (1) and (2) by using an appropriate method to get d as 2.75 km.	1
15	Matches A - 2 - iii. or Matches A) in column I with 2) in column II and iii) in column III.	1
	Matches B - 3 - i. or Matches B) in column I with 3) in column II and i) in column III.	1
	Matches C - 1 - ii. or Matches C) in column I with 1) in column II and ii) in column III.	1
16	i) Frames the pair of linear equations in two variables representing the given context as: $x + y = \frac{1}{2}$ $600x + 750y = 360$	1

Q.No	Teacher should award marks if students have done the following:	Marks
	ii) Solves the above pair of linear equations to find the values of x and y as $\frac{1}{10}$ and $\frac{2}{5}$ respectively and concludes that Arvind packed $\frac{1}{10}$ kg of cashew nuts and $\frac{2}{5}$ kg of pistachio nuts for the customer. (Award full marks if the answer is obtained in terms of grams instead of kilograms.)	2
17	Writes that the pair of linear equations $x = p$ and $y = q$, where p and q are constants, is consistent.	0.5
	Justifies the answer. For example, writes that the solution of the given pair of linear equations is $x = p$ and $y = q$ or $(x, y) = (p, q)$ and hence it is consistent.	0.5
18	i) Frames the first equation as: $x + (6 - 2)y = 110$ or $x + 4y = 110$	1
	Frames the second equation as: $x + (13 - 2)y = 250$ or $x + 11y = 250$	1
	Solves the pair of linear equations by any suitable method and finds the values of x and y as 30 and 20 respectively.	1.5
	Concludes that the fixed charge up to 2 hours is Rs 30 and the subsequent charge is Rs 20 per hour.	0.5
	ii) Calculates Amish's parking duration as 7 hours.	0.5
	Uses the values obtained in part (i) and finds Amish's parking charge as 30 + (7 - 2)20 = Rs 130.	0.5
19	Assumes the total number of marbles Ananya had as 12 x (4 x red marbles, 5 x blue marbles and 3 x yellow marbles) and the number of blue marbles Ananya gave to Neha as y.	0.5
	Frames the first linear equation as: $4x + y = 20$ ----- 1	1

Q.No	Teacher should award marks if students have done the following:	Marks
	Frames the second linear equation as: $\frac{5x-y}{3x} = \frac{7}{9}$ ----- 2	**1**
	Solves the pair of linear equations by any suitable method correctly and finds the values of *x* and *y* as 3 and 8 respectively.	**2**
	Finds the number of red marbles Ananya gave to Neha as 20 - 8 = 12.	**0.5**
20	**Writes that Garima has made a mistake in step 2.**	**0.5**
	Writes the correct equation as 3b + 7a = 12.	**0.5**
21	**Frames the pair of linear equations that represents the given context as:** ***x* + 150 *y* = 27500** ***x* + 250 *y* = 32500** **(Award 0.5 marks for each correct linear equation.)**	**1**
22	**Solves the given pair of linear equations by any suitable method:** **x + 150 *y* = 27500** ***x* + 250 *y* = 32500** **Finds the values of *x* as 20000 and concludes that the fixed cost incurred by the ice cream parlour is Rs 20,000.** **(Note: The pair of linear equations is given for reference only and the marks are to be awarded only for finding the solution of the pair of linear equations.)**	**1**
23	**Solves the given pair of linear equations by any suitable method:** **x + 150 *y* = 27500** ***x* + 250 *y* = 32500** **Finds the values of *y* as 50 and concludes that the variable cost per unit incurred by the ice cream parlour is Rs 50.** **(Note: The pair of linear equations is given for reference only and the marks are to be awarded only for finding the solution of the pair of linear equations.)**	**1**

Q.No	Teacher should award marks if students have done the following:	Marks
24	**Assuming *n* as the number of units and *m* as revenue at break-even point, frames the pair of linear equations that represents the given context as:** ***m* = 60 *n*** ***m* = 10000 + 40 *n***	**1**
	Solves the given pair of linear equations by any suitable method to find the values of *n* as 500 and concludes that the number of units at the break-even point is 500.	**1**